

mathematical study (pp. 10-16) by Dr. Shrubsall of the statistics of growth. The general results might with advantage have been further elaborated on the practical side. As to teeth, there is a strong plea for school dental clinics on the model of Strassburg.

A special investigation as to tuberculosis of the lungs in school children was undertaken by Dr. Squire and Dr. Annie Gowdey. Of actual phthisis, only 335 cases (i.e. 0.55 per cent.) were found among 58,934 children. The sections on hearing and acuity of vision contain much fresh material. One of the most important sections deals with the "development of articulatory capacity for consonantal sounds" (p. 27). Considerable detail is given of the methods of testing, and 105,000 tests were made on some 3000 children. The results are given in an exact quantitative way, capable of analytical study. This department is of immense importance to the teacher, as the work already done in phonetics has abundantly shown. As to fatigue, some new curves from rifle-shooting are given. It is found that the curve improves with a little practice, co-ordination improving very rapidly. Cigarette-smoking was found to impair the capacity to shoot straight.

There are the usual sections dealing with the inspection of defective children and cripples, country homes, infectious diseases, adenoids, &c.; but two sections must be specially named, one on the artificial lighting of school-rooms and the other on the mental and physical effects of bad ventilation. In both researches the practical results are very definite, and ought to be driven home among teachers and architects alike. Of the ventilation research, some provisional conclusions are:—"Temperatures above 65° F. give rise to definite subjective symptoms, slackness and inattention in some, headaches in others. Although it is not easy to assert definite mental alteration till about 70° F." "Symptoms do not appear at 65° if the air is kept in gentle movement by a fan in the room. With temperatures 70° F. and above, other factors being normal, there are marked symptoms and very evident deterioration in mental alertness and accuracy." At low temperatures, relative humidity does not affect the mental capacity of children, but increase of humidity increases the effects of high temperatures. Carbonic acid gas in considerable excess increases markedly the fatigue of the children. Exact details are given of the methods used.

The London County Council is to be congratulated on the issue of this mass of original and important observations in so many departments of medical inspection. Dr. Kerr's reports show the great educational possibilities of the system, which, under his guidance, has revealed many new regions for clinical and scientific research.

THEORY OF THE MIRAGE.

THE theory of the mirage forms the subject of several recent papers by Prof. Antonio Garbasso. In notes contributed to the *Atti dei Lincei*, xvi. (2), 1, 8, the author discusses the propagation of light in a heterogeneous medium, making use of the principle of least time, and considering the case of space of any number of dimensions defined by curvilinear coordinates. The space in question is supposed to be subject to the usual assumption that the square of the line-element is a homogeneous quadratic function of the differentials of the coordinates. As might be expected from the principle of least action (an analogy the applications of which to the problem are probably already known), the equations of the path can be reduced to the form of the ordinary equations of dynamics by a suitable choice of the characteristic function. The applications to the mirage itself are discussed in a paper in the *Memorie* of the Turin Academy, 1907. Prof. Garbasso claims that while the phenomenon has been studied both experimentally and theoretically, his present work fills a gap in the literature by establishing agreement of a quantitative character between the results of calculation and those of experiment.

Two kinds of mirage are distinguished, one due to the variations of density caused by diffusion between two fluids of different refrangibility initially having a plane of separation; this is called the mirage of Vince. The second kind, called the mirage of Monge, depends on

diffusion outwards from a plane boundary maintained indefinitely at the same conditions. The former condition gives three images, two direct and one inverted; the latter gives only the reflected image. Prof. Garbasso calculates the law of density from the equations of diffusion, and thus determines the equations of the trajectories of the rays of light and the form of the wave-front.

The final comparison with experiment is discussed in a paper by Luigi Rolla, also in the *Memorie* of the Turin Academy. In it the last-named author describes experiments showing how, not only has Wollaston's original artificial mirage of the Vince type been reproduced with its three images, but also the Monge mirage has been initiated, and in both cases the trajectories of the rays have been determined by observation and compared with results of theory. Moreover, a mirage with five images, observed by Parnell at Folkestone in 1869, was realised by placing over a layer of carbon bisulphide a mixture of equal parts by volume of alcohol and chloroform. Owing to the unequal rates of diffusion, the conditions give rise to five images, and this and other experiments are shown to be suitable for lecture-room demonstration.

By taking a block of gelatin containing a cavity filled with liquid which gradually diffuses into the gelatin, the corresponding images for a cylindrical or spherical distribution of density have been also produced and compared with the results of mathematical calculation.

The first and second figures show the mirages of a diaphragm somewhat in the shape of a ship produced by the medium formed by diffusion between alcohol and

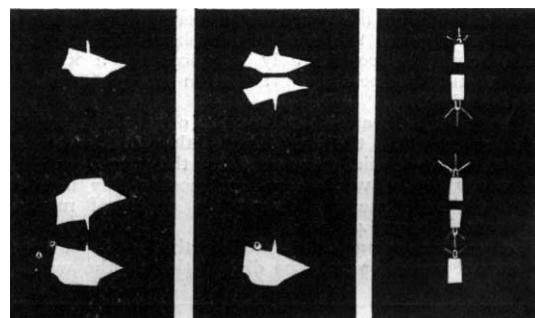


FIG. 1.

FIG. 2.

FIG. 3.

bisulphide of carbon. Fig. 1 represents the appearance after a few hours, Fig. 2 after several days. Fig. 3 shows the five images obtained by diffusion between bisulphide of carbon and a mixture of alcohol and chloroform.

G. H. B.

A CONTRIBUTION TO THE HISTORY OF IRONCLADS.

LORD ROSSE has made an interesting contribution to the history of ironclads by placing at the service of the Institution of Naval Architects copies of letters written by his father to various distinguished men in the years 1854-5. From these letters it appears that the late Lord Rosse not merely appreciated the importance of armour protection against horizontal shell fire, but satisfied himself that it was possible by means of suitable proportions to secure ample stability in ironclad ships. Naval officers were then disposed to think that the "top-weight" inevitable with heavy loads of armour would make vessels unstable. Lord Rosse proposed the construction of ironclad floating batteries of moderate size; they were intended to fight in smooth water, and consequently were to carry their guns at a small height above water. The exposed sides were to be armoured with 5 inches of iron, and the upper decks to be covered with 2-inch plating.

In a letter to Sir John Burgoyne dated June 26, 1854, Lord Rosse proposed an armament of sixteen heavy guns; the draught of water was not to exceed 12 feet to 13 feet, and the vessel was estimated to be about 1500 tons. He

added:—"All this is the roughest possible, but I think if worked out in detail the result would not be widely different. The greatest care would, of course, be necessary to guard against submarine explosives." To this letter Sir John Burgoyne replied that he doubted whether 5 inches of iron would answer its intended purpose and make a vessel practically impregnable. In this connection he remarked:—"Iron is very treacherous, and breaks, rends, and tears under very irregular effort. The Navy have a thorough dislike to it for the sides of ships, but then they have never contemplated, I believe, such thickness."

These remarks from so high an authority on ordnance as Sir John Burgoyne throw an interesting light upon opinions prevailing little more than fifty years ago in regard to naval construction. Lord Rosse was not discouraged, but proceeded to press his scheme upon the attention of the Duke of Newcastle and on Sir Baldwin Walker, who was then Controller of the Navy. In his letter to the Duke of Newcastle, Lord Rosse stated that he "had been considering, *no doubt in common with many others*, in what way the great mechanical resources of England could be brought to bear against the mechanical resources of St. Petersburg." In thus writing, Lord Rosse no doubt had in view the fact that ironclad floating batteries had been decided upon. Five such vessels were commenced in France in September, 1854, and later on similar vessels were built here, but not from Lord Rosse's outline design.

In the publication of these letters a filial duty has been fulfilled. The late Lord Rosse is shown to have been one of the first to make a definite proposal for the construction of ironclad floating batteries, and his treatment of the subject is worthy of his scientific reputation. On the other hand, it cannot be doubted that the action taken in France was independent of the suggestions of the late Lord Rosse. The correspondence with Sir John Burgoyne, the Duke of Newcastle and others could not have been known to the Emperor Napoleon when he took action; the construction of the French floating batteries was commenced about the same time as these letters were written, but was preceded by experimental trials made to determine the thickness of the armour to be adopted. It may be added that General Paixhans, to whom the introduction of horizontal shell-fire was due, had proposed the use of armour protection for ships about 1820, and Mr. Stevens began the construction of a floating battery near New York many years before the Crimean War took place. Lord Rosse obviously had no knowledge of these facts when he made the proposals above described, and acted quite independently.

THE SMITHSONIAN INSTITUTION.

THE report of the secretary of the Smithsonian Institution for the year ending June 30, 1907, has been received. It serves admirably to show the great part taken by the institution in American scientific life. Full particulars are provided, not only of the explorations and researches inaugurated by the institution, but also of the work of the U.S. National Museum, the Bureau of American Ethnology, the International Exchanges, the National Zoological Park, the Astrophysical Observatory, the Regional Bureau of the International Catalogue of Scientific Literature, and the excavations on the Casa Grande Reservation—all placed by Congress under the direction of the institution.

Reference has already been made from time to time in these pages to the researches prosecuted in connection with the institution, but it will be of interest to refer to a few which are summarised in the report. In connection with the study of the older sedimentary rocks of North America, on which Dr. Charles D. Walcott, the secretary of the institution, has been engaged during the past twenty years, upwards of 20,000 feet of strata have been carefully examined and measured. The Cambrian section has been found to include more than 12,000 feet of sandstones, shales, and limestones, and the Lower, Middle, and Upper Cambrian have been found represented in the section of Bow River series and the Castle Mountain group. Characteristic fossils have been found in each division.

An expedition in April, 1907, to Alaska to collect the remains of large extinct vertebrates, particularly mammals, has already done good work. Dr. G. P. Merrill has examined the crater-form depression near Canyon Diablo, Arizona, to determine whether it was caused by explosive volcanic action or is due to the impact of a mass of meteoric iron; his observations are being collated and arranged.

In connection with the seismological investigations undertaken to compare the disturbance in Chile with that in California, it seems to have been determined that there has been some elevation of the coast of Chile, but no traces of a rift such as caused the earthquake at San Francisco. Numerous other researches were assisted during the year; these included the absolute measure of sound, the properties of matter at very low temperatures, the study of the upper air, the organs of flight, and others.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—The council of the Senate recommends that the necessary steps be taken for altering Statute B, chapter vi., by the insertion of a paragraph giving the University power, upon the retirement of a professor, either at the date of his retirement or subsequently, to appoint him as a professor emeritus in the subject of the professorship previously held by him. A professor emeritus shall not as such receive any stipend, and shall be subject to no conditions as to duties or residence.

Dr. W. N. Shaw, of Emmanuel College, has been appointed to represent the University at the meeting of Imperial and colonial meteorologists, convened by the Royal Society of Canada, to be held at Ottawa in May.

Mr. J. S. Gardiner has been re-appointed demonstrator in animal morphology for five years as from October 1, 1907, and the appointment has been approved by the special board for biology and geology.

The special board for biology and geology reports that the Gordon Wigan income for biology and geology has been applied during 1907 as follows:—(a) a grant of 50*l.* a year to Dr. D. Sharp for a period of three years (1907–9), or such part of it during which he holds the curatorship in zoology; (b) a grant of 50*l.* a year for one year (1907) to Prof. Seward to enable the Botanic Gardens Syndicate to offer greater facilities for plant-breeding experiments; (c) a grant of 50*l.* out of the income for 1907 to Prof. Hughes, to enable Mr. E. A. N. Arber, of Trinity College, to continue his researches into the stratigraphical and geographical distribution of fossil plants.

LORD STANLEY OF ALDERLEY will distribute the prizes and certificates to evening students of the Battersea Polytechnic on Wednesday evening, February 19, and will deliver an address.

We learn from the *Pioneer Mail* that the Maharaja of Darbhanga has made a gift of nearly 17,000*l.* to the Lieutenant-Governor for the purpose of constructing a library building in connection with the Calcutta University.

The annual general meeting of the Association of Technical Institutions will be held on February 21 and 22 at the Drapers' Hall, Throgmorton Street, London. On the first day the association will be entertained at luncheon by the Drapers' Company, after which the new president, Sir Norman Lockyer, K.C.B., F.R.S., will deliver his presidential address. On the second day papers will be read on the best early training for a boy about to enter a technical institution or to take up a trade.

In a recent report, the Director of Education for the United Provinces has, in accordance with the orders of the Government of India, described the progress of education in his district during the last five years. An abridgment of the report in the *Pioneer Mail* states that the attendance at the Thomason Civil Engineering College at Roorkee has increased from 336 to 495, and various improvements in and extensions of the curriculum have been effected. An agricultural college has been opened at Cawnpore. It is hoped that the medical college at Lucknow will be in working order soon. The Thomason College will, it is